Accuracy and Precision - Density Lab

Look at archery:

bunched on bullseye	bunched off	spread but around bullseye

Accurate + Precise	Precise but not accurate	Accurate but not precise

Accuracy in measurement - the value is close to the correct or accepted measurement.
Quantify accuracy by the percentage error.

percentage error
= |experiment - theoretical|/theoretical value x 100%

eg. In the lab you will measure the density of a metal. Accepted values for the density of iron 7.87 g/cm^3, aluminum is 2.70 g/cm^3, copper 8.96 g/cm^3.
If you measured the density of and iron block to be 8.13 g/cm^3, what is the percent error of your measurement?

$=|8.13 g/cm^3 - 7.87\ g/cm^3|/7.87\ g/cm^3 \times 100\%$

$=3.3\ \%$

8.13-7.87=0.26 0.26/7.87=0.033 0.033x100=3.3

Precision - the grouping of repeated measurements. If you redid the measurements what would be the range of uncertainty? the smaller the range, the better the precision.

Use the clock to measure time, it only goes to the second. time = 2 seconds

A stopwatch gives the value to the hundredth

1.96 s.

If your reaction time is 0.2s then the stopwatch is only precise to the tenths, so you should round times to the tenths, 2.0 s.

we can quantify precision by specifying the uncertainty, +/- 0.5s or +/- 0.1s or +/- 0.01s

but an easier way is to imply the uncertainty with the number of digits used, significant digits.

2 and 2.0 and 2.000 are not the same precision

Lab activity

Purpose is to explore accuracy and precision with different measuring devices.

go measure the mass and dimensions of a metal block, either iron, copper or aluminum, calculate the density 3 times.

1. using a ruler
2. using a vernier caliper
3. using a micrometer for the widths and a vernier caliper for the length.

keep track of all the digits in the measurement, try to measure as precisely as you can.
Round your density to the least precise number of digits of the other measurements.

Observations:
type of block__________
mass of the block___________ ______ (2 balances)
length width and height

1. ruler ____ _____ _____
2. vernier caliper _____ ______ _______
3. micrometer ______ ______ caliper _______

calculate density and % error for each, compare to the precision of the measuring device
density = mass/volume = mass/(L x W x H)

Significant Digits (or Figures) rules
all non-zero numbers are significant
eg. 23.4 has 3 significant digits
zeros in the middle or after the decimal and after a sig

fig are significant
eg. 303.0 has 4 sig figs

digits used for placeholding are not significant
eg. 2.3×10^7 has only 2 sig figures
0.0000023 has only 2 significant digits
200 is unclear, put it in scientific notation
to be safe, assume just one sig fig

Assignment: finish calculating the density and percent error for your metal 3 times.
Significant figures worksheet do questions 1, 3, 4, 7, 8

density = mass/volume = mass/ (lengthxwidthxheight)

cylinder volume= pi x r^2 x h